



UNIVERSITY OF SARGODHA  
OFFICE OF THE REGISTRAR  
(ACAD BRANCH)

NOTIFICATION

The Academic Council in its 19<sup>th</sup> (4/2023) meeting held on 13.09.2023, has recommended the curricula of the following academic programs for implementation on provisional basis for affiliated colleges w.e.f Fall 2023 subject to approval by the Syndicate:-

1.	Associate Degree in Urdu	(Annex-'A')
2.	Associate Degree in Islamic Studies	(Annex-'B')
3.	Associate Degree in English (Linguistics)	(Annex-'C')
4.	Associate Degree in English (Language & Literature)	(Annex-'D')
5.	Associate Degree in Information Management	(Annex-'E')
6.	Associate Degree in Arabic	(Annex-'F')
7.	Associate Degree in Persian	(Annex-'G')
8.	Associate Degree in Punjabi	(Annex-'H')
9.	Associate Degree in Media and Communication Studies	(Annex-'I')
10.	Associate Degree in Physical Education	(Annex-'J')
11.	Associate Degree in Chemistry	(Annex-'K')
12.	Associate Degree in Bio-Chemistry	(Annex-'L')
13.	Associate Degree in Physics	(Annex-'M')
14.	Associate Degree in Statistics	(Annex-'N')
15.	Associate Degree in Botany	(Annex-'O')
16.	Associate Degree in Mathematics	(Annex-'P')
17.	Associate Degree in Geography	(Annex-'Q')
18.	Associate Degree in Biotechnology	(Annex-'R')
19.	Associate Degree in Zoology	(Annex-'S')
20.	Associate Degree in History	(Annex-'T')
21.	Associate Degree in Pakistan Studies	(Annex-'U')
22.	Associate Degree in Education	(Annex-'V')
23.	Associate Degree in Commerce	(Annex-'W')
24.	Associate Degree in Sociology	(Annex-'X')
25.	Associate Degree in Social Work	(Annex-'Y')
26.	Associate Degree in Economics	(Annex-'Z')
27.	Associate Degree in Psychology	(Annex-'ZA')
28.	Associate Degree in International Relations	(Annex-'ZB')
29.	Associate Degree in Political Science	(Annex-'ZC')

  
(WAQAR AHMAD)  
Additional Registrar (General)

No. SU/Acad/23/980

Dated: 18.10.2023

Distribution:

- Controller of Examinations (with the request to upload on University Website for affiliated Colleges)

C.C:

- Director Academics
- Director, QEC
- Additional Registrar (Affiliation & Registration)
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

1. **Title of Degree Program:** AD in Zoology

2. **Program Learning Objectives:** The Department of Zoology comprises of diverse and enthusiastic faculty members and researchers who aim to develop the best possible research environment among the students in the field of Zoology. We intend to train the student in a wide range of basic and applied field of Zoology like Vertebrate and Invertebrate Zoology, Cell and Molecular Biology, Physiology, Genetics, Developmental Biology, Ecology, Toxicology, Microbiology, Vascular Biology, Immunology Integrated pest management, Endocrinology.

3. **Program Structure:**

<b>Duration</b>	2 years (4 semesters)		
<b>Admission Requirements:</b>	<b>Eligibility:</b> Students with Pre-Medical combination in HSSC / A-level with Biology as an elective subject after 12-years of education		
<b>Degree Completion Requirements:</b>	Comprises of 4 semesters with minimum 60 credit hours; the outline of the courses is as under:		
	General Education	GE	(31 CHs)
	Interdisciplinary	ID	(08 CHs)
	Disciplinary / Major	D	(30 CHs)
	Total		69

4. **General Education (Gen Ed) Requirements: (Mandatory/Core Courses):**

*The minimum requirement for Gen Ed is 31 credits hours and will be offered in first four semesters only.*

Sr. No.	Semester	Course Code	Course Title	Credit Hours	Prerequisite
1.	2	URCG-5112	Fables, Wisdom and EPICS	2(2-0)	Nil
2.	4	URCG-5115	The Science of Global Challenges	3(2-1)	Nil
3.	2	URCG-5116	Science of Society-I	2(2-0)	Nil
4.	1	URCG-5118	Functional English	3(3-0)	Nil
5.	3	URCG-5119	Expository Writing	3(3-0)	Nil
6.	2	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
7.	3	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
8.	1	URCG-5105/ URCG-5126	Islamic Studies (OR) Religious Education/Ethics	2(2-0)	Nil
9.	3	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
10.	1	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
11.	4	URCG-5124	Entrepreneurship	2(2-0)	Nil
12.	4	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
13.	1-4	URCG-5111	Translation of Holy Quran	NC	Nil
14.	2	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
<b>GE Courses Credit Hours Total</b>				<b>31</b>	

5. **Single Major Courses:**

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite
1.	ZOOL-5101*	Animal Diversity-I (Invertebrates)	4(3-1)	nil
2.	ZOOL-5102*	Animal Diversity-II (Chordates)	4(3-1)	ZOOL-5101
3.	ZOOL-5103*	Animal Form & Function-I	4(3-1)	nil
4.	ZOOL-5104*	Animal Form & Function-II	4(3-1)	ZOOL-5103
5.	ZOOL-5105*	Economic Zoology	3(2-1)	nil
6.	ZOOL-5106*	Cell and Molecular Biology	4(3-1)	nil
7.	ZOOL-5107*	Biochemistry	4(3-1)	nil

8.	ZOOL-5108*	Fisheries	3(2-1)	nil
<b>Major Courses Credit Hours Total</b>			<b>30</b>	

\*Zoology courses (semester I-IV) can be rotated with subject to availability of teacher in that specialized field.

**6. Interdisciplinary/Allied courses: minimum 12 credit hours:**

1.	BOTN-5101	Diversity of Plants	4(3-1)	
2.	CHEM5101	Inorganic Chemistry	4(3-1)	
<b>Interdisciplinary Courses Credit Hours Total</b>			<b>08</b>	

**Scheme of Studies**  
**Associate Degree in Zoology**  
**(For Affiliated Colleges)**

**Semester-I**

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-01	URCG-5118	Functional English	3(3-0)	Nil
GE-02	URCG-5105 URCG-5126	Islamic Studies (OR) Religious Education/Ethics	2(2-0)	Nil
GE-03	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
GE-04	URCQ-5111	Translation of the Holy Quran – I	NC	Nil
Major-1	ZOOL-5101	Animal Diversity-I (Invertebrates)	4(3-1)	Nil
Major-2	ZOOL-5102	Animal Form and Function- I (A Comparative Perspective)	4(3-1)	Nil

Semester Total Credit Hours: 16

**Semester-II**

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-05	URCG-5112	Fables, Wisdom and EPICS	2(2-0)	Nil
GE-06	URCG-5116	Science of Society-I	2(2-0)	Nil
GE-07	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
GE-08	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
Major-03	ZOOL-5103	Animal Diversity-II (Chordates)	4(3-1)	ZOOL-5101
Major-04	ZOOL-5104	Animal Form & Function-II	4(3-1)	ZOOL-5103

Semester Total Credit Hours: 16

**Semester-III**

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-09	URCG-5119	Expository Writing	3(3-0)	Nil
GE-10	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
GE-11	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
GE-4	URCQ-5111	Translation of Holy Quran-II	NC	Nil
Major-5	ZOOL-5105	Economic Zoology	3(2-1)	Nil
Major-6	ZOOL-5106	Cell and Molecular Biology	4(3-1)	Nil
ID-01	CHEM-5102	Inorganic Chemistry	4(3-1)	Nil

Semester Total Credit Hours: 19

**Semester-IV**

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-12	URCG-5115	The science of global challenges	3(2-1)	Nil
GE-13	URCG-5124	Entrepreneurship	2(2-0)	Nil
GE-14	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
Major-07	ZOOL-5107	Biochemistry	4(3-1)	Nil
Major-08	ZOOL-5108	Fisheries	3(2-1)	Nil
ID-02	BOTN-5101	Diversity of Plants	4(3-1)	Nil

Semester Total Credit Hours: 18

Degree Total Credit Hours: 69

**Note:** Courses of Translation of Holy Quran and Seerat of the Holy Prophet (SAW) should be for Muslim students only

## SEMESTER I

Course Code	URCG-5118	Course Title	Functional English	Credit Hours	3(3-0)
-------------	-----------	--------------	--------------------	--------------	--------

### Course Brief:

The course aims at providing understanding of a writer's goal of writing (i.e. clear, organized and effective content and to use that understanding and awareness for academic reading and writing. The objectives of the course are to make the students acquire and master the grammatical academic writing skills. The course would enable the students to develop argumentative writing techniques. The students would be able to logically add specific details on the topics such as facts, examples and statistical or numerical values.

### Course Learning Objectives:

The course will also provide insight to convey the knowledge and ideas in an objective and persuasive manner. Furthermore, the course will also enhance the students' understanding of ethical considerations in writing academic assignments and topics including citation, plagiarism, formatting and referencing the sources as well as the technical aspects involved in referencing.

### Course Contents:

1. Developing Analytical Skills
2. Transitional devices (word, phrase and expressions)
3. Development of ideas in writing
4. Reading Comprehension
5. Precis Writing
6. Developing argument
7. Sentence structure: Accuracy, variation, appropriateness, and conciseness
8. Appropriate use of active and passive voice
9. Organization and Structure of a Paragraph
10. Organization and structure of Essay
11. Types of Essays

### Recommended Texts:

1. Bailey, S. (2011). *Academic writing: A handbook for international students* (3rd ed.). New York: Routledge.
2. Eastwood, J. (2011). *A Basic English grammar*. Oxford: Oxford University Press.
3. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3<sup>rd</sup> ed.). Ann Arbor: The University of Michigan Press.
4. Swan, M. (2018). *Practical English usage* (8<sup>th</sup> ed.). Oxford: Oxford University Press.

### Suggested Readings:

1. Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). *Longman grammar of spoken and written English*. Harlow Essex: MIT Press.

2. Cresswell, G. (2004). *Writing for academic success*. London: SAGE.
3. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
4. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*.

Washington: American Psychological Association

5. Thomson, A. J., & Martinet, A. V. (1986). *A Practical English Grammar*. Oxford: Oxford University Press

Course Code	URCG-5105	Course Title	Islamic Studies (Compulsory)	Credit Hours	2(2-0)
-------------	-----------	--------------	---------------------------------	--------------	--------

### Course Brief:

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam;

Qur'an and Hadith, history and particular cultural contexts. The area seeks to provide an introduction to and a specialization in Islam through a large variety of expressions (literary, poetic, social, and political) and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology). It offers opportunities to get fully introductory foundational bases of Islam in fields that include Qur'anic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qur'an and Sunnah.

### Course Learning Objectives:

1. To make students understand the relevance and pragmatic significance of Islam in their lives.
2. To make learners comprehend the true spirit of Islam with reference to modern world.
3. To generate a sense of Islamic principles as a code of living that guarantee the effective solutions to the current challenges of being.
4. To provide Basic information about Islamic Studies
5. To enhance understanding of the students regarding Islamic Civilization
6. To improve Students skill to perform prayers and other worships
7. To enhance the skill of the students for understanding of issues related to faith and religious life

### Course Contents:

#### Introduction to Qur'anic Studies

1. Basic Concepts of Qur'an
2. History of Quran
3. Uloom-ul-Quran

مطالعه قرآن (تعارف قرآن، منتخب آیات کا ترجمہ و تفسیر: سورة البقرہ آیات 1-5، 482-482؛ سورة الحجرات آیات 1-18؛ سورة الفرقان آیات 26-77؛ سورة المومنون آیات 1-11؛ سورة الحزاب آیات 2، 41، 64-66؛ 24، 52-55؛ سورة النعام آیات 151-156؛ سورة الصف آیات 1-12؛ الحشر آیات 18-44؛ آل عمران آیات 154-154؛ النحل آیات 14-12؛ لقمن آیت 44، حم السجده آیت 65)

#### Introduction to Sunnah

1. Introduction of Hadith
2. Legal Status of Hadith
3. History of the compilation of Hadith 4. Kinds of Hadith

حدیث کا تعارف، حدیث کی دینی حیثیت، حفاظت و تدوین حدیث، حدیث کی اقسام متن، حدیث: 1درج ذیل موضوعات پر احادیث کا مطالعہ

1. اعمال کا اجر نیت پر منحصر ہے۔ 4. بہترین انسان قرآن کا طالب علم اور اس کا معلم ہے۔ 6. کتاب و سنت گمراہی سے بچنے کا ذریعہ ہیں۔ 2. ارکان اسلام 5. اسلام، ایمان، احسان اور قیامت کی نشانیاں، 2 بچوں کی نماز کی تلقین 7. دین کا گہرا فہم بلا کی خاص عنایت ہے 8. حصول علم، تالوت قرآن اور عمل کی اہمیت و فضیلت، 5۔ روز محشر کا محاسبہ، 14۔ حقوق بلا کے ساتھ ساتھ حقوق العباد کا لحاظ رکھنا بھی الزم ہے 11۔ حسن خلق کی عظمت اور فحش و بدگونی کی مذمت 14۔ دنیا و آخرت کی بھاننی کی ضامن چار چیزیں، 16۔ مالک کر دینے والی سات چیزیں، 12۔ بے عمل مبلغ کا عبرت ناک انجام 15۔ ہر شخص

نگران ہے اور ہر شخص مسنول

1. Sirah of the Prohet
2. Importance of the Study of Sirah
3. Character building method of the Prophet

(سیرت النبی ﷺ) مطالعہ سیرت کی ضرورت و اہمیت، تعمیر، سیرت و شخصیت کا نبوی منہاج اور عملی نمونے، اقامت دین کا نبوی طریق کار، اقامت دین بعدِ خلافت راشدہ، میثاق مدینہ، خطبہ حجۃ الوداع، اخلاقی تعلیمات، تشکیل اجتماعی اور

ت نبوی ﷺ کے مقاصد و حکمتیں

#### Islamic Culture & Civilization

1. Basic Concepts of Islamic Culture & Civilization
2. Historical Development of Islamic Culture & Civilization
3. Characteristics of Islamic Culture & Civilization
4. Islamic Culture & Civilization and Contemporary Issues

2. اسلامی تہذیب و تمدن (اسلامی تہذیب کا مفہوم، اسلامی کے عوامل و عناصر، اسلامی تہذیب کی خصوصیات، اسلامی تہذیب، علمی، معاشرتی اور سماجی اثرات، تہذیبوں کے تصادم کے نظریے کا تنقیدی جائزہ، تہذیبی تصادم کے اثرات و نتائج، طبعی، حیاتیاتی اور معاشرتی علوم میں مسلمانوں کا کردار، نام و مسلمان سائنسدان (سورہ حسنہ، قرآن مجید میں سیرت سرور عالم کا بیان، غزوا

#### Recommended Texts:

1. Hameed ullah Muhammad, —Emergence of Islam|| , IRI, Islamabad
2. Hameed ullah Muhammad, —Muslim Conduct of State
3. Hameed ullah Muhammad, \_Introduction to Islam
4. Ahmad Hasan, —Principles of Islamic Jurisprudence|| Islamic Research, Institute, International Islamic University, Islamabad (1993)

#### Suggested Readings:

1. Dr. Muhammad Zia-ul-Haq, —Introduction to Al Sharia Al Islamia|| Allama Iqbal Open University, Islamabad (2001)
2. Dr. Muhammad Shahbaz Manj, Teleemat-e- Islam

<b>Course Code</b>	URCG-5126	<b>Course Title</b>	ETHICS	<b>Credit Hours</b>	2(2+0)
--------------------	-----------	---------------------	--------	---------------------	--------

**Course Contents:**

1. Meaning and Scope of Ethics.
  2. Relation of Ethics with:
    - (a) Religion
    - (b) Science
    - (c) Law
  3. Historical Development of Morality: (a). Instinctive Moral Life.  
(b). Customary Morality. (c). Reflective Morality.
  4. Moral Theories:
    - (a). Hedonism (Mill) (b). Intuitionism (Butler)
    - (c). Kant's Moral Theory.
  5. Moral Ethics and Society.
    - (a). Freedom and Responsibility. (b). Tolerance
    - (c). Justice
    - (d). Punishment (Theories of Punishment)
  6. Moral Teachings of Major Religions: a). Judaism  
b). Christianity c). Islam 7.
- Professional Ethics:
- a). Medical Ethics b). Ethics of Students
  - c). Ethics of Teachers d). Business Ethics

**Recommended Texts:**

1. William Lille. An Introduction to Ethics., London Methuen & Co. latest edition.
2. Titus, H.H. Ethics for Today. New York: American Book, latest edition.
3. Hill, Thomas. Ethics in Theory and Practice. N.Y. Thomas Y. Crowel, latest edition

**Suggested Readings:**

1. Ameer Ali, S. The Ethics of Islam. Culcutta: Noor Library Publishers, latest edition
2. Donaldson, D.M. Studies in Muslim Ethics. London: latest edition. 6. Sayeed, S.M.A.(Tr.) Ta'aruf-e-Akhlaqiat. Karachi: BCC&T, Karachi University.

<b>Course Code</b>	URCG-5123	<b>Course Title</b>	Applications of Information Communication Technologies (ICT)	<b>Credit Hours</b>	3 (2-1)
--------------------	-----------	---------------------	--------------------------------------------------------------	---------------------	---------

**Course Brief:**

The course introduces students to information and communication technologies and their application in the workplace. Objectives include basic understanding of computer software, hardware, and associated technologies. How computers can be used in the workplace, how communications systems can help boost productivity, and how the Internet technologies can influence the workplace.

**Course Learning Objectives:**

Students will get basic understanding of computer software, hardware, and associated technologies. They will also learn how computers are used in the workplace, how communications systems can help to boost productivity, and how the Internet technologies can influence the workplace.

**Course Contents:**

1. Introduction, Overview of Information Technology.
2. Hardware: Computer Systems & Components, Storage Devices.
3. Software: Operating Systems, Programming and Application Software.
4. Databases and Information Systems Networks.
5. File Processing Versus Database Management Systems.
6. Data Communication and Networks.
7. Physical Transmission Media & Wireless Transmission Media.
8. Applications of smart phone and usage.
9. The Internet, Browsers and Search Engines.
10. Websites and their types.
11. Email Collaborative Computing and Social Networking.
12. E-Commerce.
13. IT Security and other issues.
14. Cyber Laws and Ethics of using Social media.
15. Use of Microsoft Office tools (Word, Power Point, Excel) or other similar tools depending on the operating system.
16. Other IT tools/software specific to field of study of the students if any.

**Recommended Texts:**

1. Discovering Computers 2022: Digital Technology, Data and Devices by Misty E. Vermaat, Susan L. sebok; 17<sup>th</sup> edition.

**Suggested Readings:**

1. Computing Essentials 2021 by Timothy J. O'Leary and Linda I. O'Leary, McGraw Hill Higher Education; 26<sup>th</sup> edition.
2. Computers: Understanding Technology by Fuller, Floyd; Larson, Brian: edition 2018.

Course Code	URCQ-5111	Course Title	Translation of the Holy Quran – I	Credit Hours	Non-Credit
-------------	-----------	--------------	-----------------------------------	--------------	------------

**Course Brief:**

- To familiarize the students to keys and fundamentals of recitation of the holy Quran.
- To develop the skill of the students of recitation the last revelation.

**Course Learning Objectives:**

- Students will learn the basic Arabic grammar in a practical way.
- To develop an eagerness among the students to explore the last divine Book. **Course Contents:**

تیسواں پارہ - ناظرہ مع تجوید بنیادی عربی گرامر اسم اور اسکے متعلقات : اسم فاعل ، مفعول ، تفضیل ، مبالغہ  
 فعل اور اسکی اقسام : ماضی ، مضارع ، امر ، نہی حروف علت ، حروف جارہ ، مشبہ بالفعل : حرف اور اسکی اقسام

**Memorization**

( حفظ مع ترجمہ ) تیسویں پارے کی آخری بیس سورتیں

<b>Course Code</b>	ZOOL-5101	<b>Course Title</b>	Animal Diversity-I (Invertebrates)	<b>Credit Hours</b>	4(3-1)
--------------------	-----------	---------------------	---------------------------------------	---------------------	--------

**Course Brief:**

This course will provide the knowledge of evolutionary/phylogenetic relationship. It imparts the basic taxonomic characteristics and classification of all the invertebrate phyla. This includes more than 95% of all of the described species of animals and far more than 99% of all of the individual animals on the planet. The central theme running throughout this course will be phylogeny. It provides understanding of body organization, mode of feeding, digestion, reproduction and development of invertebrates. It delivers information to students about economic and ecological importance of invertebrates. Students will understand invertebrate organismal concepts in laboratory and field.

**Course Learning Objectives:**

The primary objectives for the laboratory section of this course includes; introduction of structure, function and behavior of selected invertebrate types through the observation of both living and preserved specimens, to reinforce basic laboratory skills of students like microscopy, dissection and careful observation, to provide students with the ability to recognize the major groups of invertebrate and to increasing understanding of the methods of investigating animal evolution. **Course Contents:**

1. Introduction: classification of organisms, evolutionary relationships and tree diagrams: patterns of organization.
2. Animal-like protists: the protozoa: evolutionary perspective; life within a single plasma membrane, symbiotic life-styles, Protozoon taxonomy, pseudopodia and amoeboid locomotion; cilia and other pellicular structure, nutrition; genetic control and reproduction; symbiotic ciliates, further phylogenetic consideration.
3. Multicellular and tissue levels of organization: Evolutionary Perspective, Origins of Multicellularity; Animal Origins, Phylum Porifera, Cnidaria, Ctenophora, Characters and Classification, Maintenance functions.
4. The triploblastic and with acoelomate body plan: Phylum Platyhelminthes, Phylum Nematode, Gastrotricha, evolutionary perspective; classification up to class, body plan and functions.
5. Pseudocoelomate body plan: Phylum Aschelminths, evolutionary perspective; general characteristics; classification up to order with external features, feeding and digestive system; other organ system; reproduction and development including Phylum Rotifera, Phylum Nematoda and Phylum Kinorhyncha. some important nematode parasites of human.
6. Phylum Mollusca: evolutionary perspective; relationship to other animals; origin of the coelom; characteristics, classification up to class. the characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion, reproduction and development, other maintenance functions and diversity in gastropods, bivalves and cephalopods.
7. Phylum Annelida: the metameric body form; evolutionary perspective; relationship to other animals, metamerism and tagmatization, classification up to class. external structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development, Polychaeta, Oligochaeta and Hirudinea, Further phylogenetic consideration.

8. Phylum Arthropoda: evolutionary perspective: classification and relationship to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class.
9. The Hexapods and Myriapods: evolutionary perspective: classification upto class. external structure and locomotion, nutrition and the digestive system, gas exchange, circulation and temperature regulation, nervous and sensory functions, excretion, chemical regulation, reproduction and development in hexapoda, insects behavior, insect and human.
10. Phylum Echinoderms: evolutionary perspective: relationship to other animals; echinoderm characteristics; classification up to class, maintenance functions, regeneration, reproduction, and development in Asterozoa, Ophiurozoa, Echinozoa, Holothurozoa and Crinozoa.
11. Some lesser known Invertebrates: Lophophorates, Entoprocts, Cycliophores, and Cheatognaths.

### *Practical*

Note: Classification of each member of each phylum upto order with adaptations in relation to habitat of the specimen. Preserved specimen and colored projection slide and CD ROM projection of computer must be used.

1. Study of Euglena, Amoeba, Endameba, Plasmodium, Trypanosome, Paramecium as representative of animal like Protists.
2. Study of representatives of Phylum Porifera and prepared slides of spicules of sponges
3. Study of principal representatives of classes of Phylum Coelenterate.
4. Study of principal representatives of classes of Phylum Platyhelminthes.
5. Study of representatives of phylum Rotifer, Phylum Nematode.
6. Study of principal representatives of classes of Phylum Mollusca.
7. Study of principal representatives of classes of Phylum Annelida.
8. Study of principal representatives of classes of groups of Phylum Arthropoda
9. Study of representatives of classes of Phylum Echinodermata.
10. Preparation of permanent mount of Leucosolenia, Obelia, Hydra, Proglottid of Tapeworm, Parapodia of Nereis and Daphnia. Drawing and labeling.
11. Preparation of permanent slide of mouthpart of insects (after dissection).
12. How to make grade-wise series for preparation of temporary and permanent slides.

### **Recommended Texts:**

1. Miller, A. S., & Harley, J. P. (2016 & 2019). *Zoology* (10 & 11 ) Singapore: McGraw Hill
2. Hickman, C. P., Roberts, L. S., Keen, S. L., Larson, A., l'Anson, H & Eisenhour., D. J. (2009). *Integrated principles of zoology* (14<sup>th</sup> ed.). Singapore: McGraw-Hill.
3. Hickman, C. Jr., Keen, S., Eisenhour, D., Larson, A., l'Anson, H., (2019). *Integrated principles Of zoology* (18<sup>th</sup> ed.). Singapore: McGraw-Hill.

**Suggested Readings:**

1. Hickman, C. P., Roberts, L. S., & Larson, A. (2018). *Integrated principles of zoology* th (15 ed.). Singapore: McGraw-Hill.
2. Hickman, C., Jr., Keen, S., Eisenhour, D., Larson, A., l'Anson, H., (2019). *Integrated principles of zoology* (18<sup>th</sup> ed.). Singapore: McGraw-Hill.
3. Pechenik, J. A. (2015). *Biology of invertebrates* (7<sup>th</sup> ed.). Singapore: McGraw-Hill

<b>Course Code</b>	ZOOL-5102	<b>Course Title</b>	Animal Form and Function-I (A Comparative Perspective)	<b>Credit Hours</b>	4(3-1)
--------------------	-----------	---------------------	-----------------------------------------------------------	---------------------	--------

**Course Brief:**

This course teaches about animal diversity adapted strategically for performance of their similar functions through modifications in body parts in past and present times. It imparts understanding of diverse structural adaptations in each of the functions of integumentary, skeletal, muscular, nervous, sensory, endocrine, circulatory and respiratory systems for effective survival in their specific conditions.

**Course Learning Objectives:**

The course mainly aims to teach the students about animal diversity adapted in different ways for their functions through modifications in body parts, about the diversity in integumentary, skeletal, muscular, nervous and sensory, endocrine, circulatory, respiratory, nutritive, excretory, osmoregulatory and reproductive systems according to strategies to survive in their specific conditions. It will also introduce about organ systems, their specialization and coordination with each other and constantly changing internal and external environment, inside and outside the animal's body along with the basic structure of each system that determines its particular function of animal body.

**Course Contents:**

1. Protection, support, and movement: protection: the integumentary system of invertebrates and vertebrates; movement and support: the skeletal system of invertebrates and vertebrates; movement: non-muscular movement; an introduction to animal muscles; the muscular system of invertebrates and vertebrates
2. Communication I: nerves: neurons: structure and function.
3. Communication II: senses: sensory reception: baroreceptors, chemoreceptors, georeceptors, hygroreceptors, phonoreceptors, photoreceptors, proprioceptors, tactile receptors, and thermoreceptors of invertebrates lateral line system and electrical sensing, lateral-line system and mechanoreception, hearing and equilibrium in air and water, skin sensors of mechanical stimuli, sonar, smell, taste and vision in vertebrates.
4. Communication III: The Endocrine System and Chemical Messengers: Chemical messengers: hormones chemistry; and their feedback systems; mechanisms of hormone action, Hormones with principal function each of porifera, cnidarians, platyhelminthes, nemertean, nematodes, molluscs, annelids, arthropods, and echinoderms invertebrates; an overview of the vertebrate endocrine system; endocrine systems of vertebrates, endocrine systems of birds and mammals
5. Circulation and immunity: internal transport and circulatory systems in invertebrates characteristics of invertebrate coelomic fluid, hemolymph, and blood cells, transport systems in vertebrates; characteristics of vertebrate blood, blood cells and vessels; the hearts and circulatory systems of bony fishes, amphibians, reptiles, birds and mammals; the human heart: blood pressure and the lymphatic system; immunity: nonspecific defenses, the immune response.

**Practical:**

1. Study of insect chitin, fish scale, amphibian skin, reptilian scales, feathers and mammalian skin. 2. Study and notes of skeleton of Labeo (*Labeo rohita*), Frog (*Hoplobatrachus tigerinus*), Varanus (*Varanus bengalensis*), fowl (*Gallus domesticus*) and rabbit (*Oryctolagus cuniculus*).

Note: Exercises of notes on the adaptations of skeletons to their function must be done.

3. Earthworm or leech; cockroach, freshwater mussel, Channa or *Catla catla* or Labeo or any other local fish, frog, pigeon and rat or mouse and rabbit's dissections as per availability.
4. Study of heart, principal arteries and veins in a representative vertebrate (dissection of representative fish/mammals)

**Recommended Texts:**

1. Miller, A. S., & Harley, J. P. (2016 & 2019). *Zoology* (10<sup>th</sup> & 11<sup>th</sup> ed). Singapore: McGraw Hill
2. Hickman, C. P., Roberts, L. S., Keen, S. L., Larson, A., l'Anson, H & Eisenhour., D. J. (2009).

*Integrated principles of zoology* (11 ed.). Singapore: McGrawHill.

**Suggested Readings:**

1. Hickman, C., Jr., Keen, S., Eisenhour, D., Larson, A., l'Anson, H., (2019). *Integrated principles of th zoology* (18 ed.). Singapore: McGraw-Hill.
2. Pechenik, J. A. (2015). *Biology of invertebrates* (7 ed.). Singapore: McGraw-Hill
3. Kent, G. C., & Miller, S. (2001). *Comparative anatomy of vertebrates*. New York: McGraw-Hill.

## SEMESTER II

Literature

Course Code	URCG-5112	Course Title	Fables, Wisdom and Epics	Credit Hours	2(2-0)
-------------	-----------	--------------	--------------------------	--------------	--------

### Course Brief:

The course will enable students to explore human experiences, cultivate an appreciation of the past, enrich their capacity to participate in the life of their times, and enable an engagement with other cultures and civilizations, both ancient and modern. But independently of any specific application, the study of these subjects teaches understanding and delight in the highest achievements of humanity. The three components of the course, including fables, wisdom literature and epic, will enable the learners to explore and understand the classic tradition in literature.

### Course Learning Objectives:

Development of personal virtue, a deep Sufi ethic and an unwavering concern for the permanent over the fleeting and the ephemeral are some of the key themes explored in the contents that will develop an intimate connection between literature and life.

### Course Contents:

1. Fables
  - The Fables of Bidpai
  - The Lion and the Bull
  - The Ring-dove
  - The Owls and the Crows
  - Selected poem from Bang-i-Dara
2. Gulistan-e- Sa'di
  - Ten hikāyāt from John T. Platts, *The Gulistan*
3. Epic
  - THE SHĀHNĀMA OF FIRDAUSI

### Recommended Texts:

1. Chishti, Y.S. (1991). *Sharaḥ-i bāng-i darā*. Lāhaur: Maktaba-i ta'mīr-i insāniyat
2. John T. P. (1876). *The Gulistan; or, Rose Garden of Shaikh Muslihu 'd- Dīn Sa 'dī of Shīrāz*. London: Wm. II. Allen.

### Suggested Readings:

1. Thackston, W. (2000). *A Millennium of Classical Persian Poetry*. Maryland: Ibex Publishers.
2. Wood, R. (2013). *Kalila and Dimna: Fables of Conflict and Intrigue*. United

<b>Course Code</b>	URCG-5116	<b>Course Title</b>	Science of Society-I	<b>Credit Hours</b>	2 (2-0)
--------------------	-----------	---------------------	----------------------	---------------------	---------

**Course Brief:**

This course will introduce students with the subject matter of social science, its scope, nature and ways of looking at social phenomenon. It will make the participants acquaintance with the foundations of modern society, state, law, knowledge and selfhood. While retaining a focus on Pakistani state and society, students will encounter theoretical concepts and methods from numerous social science disciplines, including sociology, politics, economics anthropology and psychology and make them learn to think theoretically by drawing on examples and case studies from our own social context. Students will be introduced to the works of prominent social theorists from both western and non-western contexts. Instruction will include the use of written texts, audio-visual aids and field visits.

**Course Learning Objectives:** The course has following outcomes: It will

- Introduce student with the nature of human social behavior and foundations of human group life
- Analyze the reciprocal relationship between individuals and society.
- Make student aware with the nature of societies existing in modern world
- Make students familiar with the philosophy of knowledge of social sciences
- Introduce students with the works of prominent theories explain human group behavior
- Help students to understand the foundations of society including culture, socialization, politics and economy
- Introduce students with various dimensions of social inequalities with reference to gender, race, ethnicity and religion
- Make them aware about the understanding of various themes pertains to social science in local context
- Help them recognize the difference between objective identification of empirical facts, and subjective formulation of opinionated arguments

**Course Contents:**

**1. Introduction to Social Sciences**

- Social world, Human Social behavior, Foundations of society
- Evolution of Social sciences
- Philosophy of Science
- Scope and nature of social sciences
- Modernity and social sciences
- Branches of social science: Sociology, Anthropology, Political Science, Economics

**Society and Community, Historical evolution of Society**

- Types of Societies
- Foraging society, Horticultural society, Pastoralist society
- Agrarian societies, Industrial society, Postindustrial society

**2. Philosophy of Knowledge in social Science and social inquiry**

- Understanding social phenomenon
- Alternative ways of knowing

- Science as a source to explore social reality
  - Objectivity, Value-Free research
  - Positivism vs Interpretivism
  - Qualitative vs Quantitative
- 3. Culture and Society**
- Idea of Culture, Assumptions of Culture
  - Types, Components, Civilization and culture
  - Individual and culture. Cultural Ethnocentrism, Cultural Relativism
  - Outlook of Pakistani culture
  - Global Flows of culture, Homogeneity, Heterogeneity
- 4. Social Stratification and Social inequality**
- Dimensions of inequality, Social class
  - Gender, Race, Religion, Ethnicity, Caste
  - Patterns of social stratification in Pakistan
  - Class, caste system in agrarian society
  - Ascription vs Achievement, Meritocracy
  - Global stratification in modern world, Global patterns of inequality
- 5. Personality, Self and Socialization**
- Concept of self, Personality
  - Nature vs Nurture, Biological vs Social
  - Development of Personality
  - Socialization as a process, Agents of socialization
  - Socialization and self/group identity
- 6. Gender and Power**
- Understanding Gender
  - Social construction of Patriarchy
  - Feminism in Historical context, Gender Debates
  - Gender and Development
  - Gender issues in Pakistani society, Women Participation in politics, economy and education
  - Toward a gender sensitive society, Gender mainstreaming
- Pakistan: State, Society, Economy and Polity**
- Colonialism, colonial legacy, National identity
  - Transformation in Pakistani society: Traditionalism vs Modernism
  - Economy, Informality of Economy, Modern economy and Pakistan
  - Political Economy, Sociology of Economy

**Recommended Texts:**

1. Giddens, A. (2018). Sociology (11<sup>th</sup> ed.). UK: Polity Press.
2. Henslin, J. M. (2018). Essentials of Sociology: A Down-to-Earth Approach.(18<sup>th</sup> Edition) Pearson Publisher.
3. Macionis, J. J. (2016). Sociology (16<sup>th</sup> ed.). New Jersey: Prentice-Hall.

4. Qadeer, M. (2006) Pakistan - Social and Cultural Transformation in a Muslim Nation.
5. Smelser, N.J. and Swedburg, R., The Handbook of Economic Sociology, Chapter 1 'Introducing Economic Sociology', Princeton University Press, Princeton.

**Suggested Readings:**

1. Systems of Stratification | Boundless Sociology (no date). Available at: <https://courses.lumenlearning.com/boundless-sociology/chapter/systems-of-stratification/>
2. Jalal, A. (ed.) (1995) 'The colonial legacy in India and Pakistan', in Democracy and Authoritarianism in South Asia: A Comparative and Historical Perspective. Cambridge: Cambridge University Press (Contemporary South Asia)
3. Zaidi, S. A. (2015) Issues in Pakistan's Economy: A Political Economy Perspective. Oxford University Press. Chapter 26
4. Akhtar, A. S. (2017) The Politics of Common Sense: State, Society and Culture in Pakistan. Cambridge: Cambridge University Press.  
Smelser, N.J. and Swedburg, R., The Handbook of Economic Sociology, Chapter 1 'Introducing Economic Sociology', Princeton University Press, Princeton.

<b>Course Code</b>	URCG-5120	<b>Course Title</b>	Exploring Quantitative Skills	<b>Credit Hours</b>	3(3-0)
--------------------	-----------	---------------------	----------------------------------	---------------------	--------

**Course Brief:**

Since ancient times, numbers, quantification, statistics and mathematics has played a central role in scientific and technological development. In the 21st century, Quantitative Reasoning (QR) skills are essential for life as they help to better understand socio-economic, political, health, education, and many other issues, an individual now faces in daily life.

**Course Learning Objectives:**

The skills acquired by taking this course will help the students to apply QR methods in their daily life and professional activities. This course will also change student’s attitude about statistics and mathematics. It will not only polish their QR skills, but also enhance their abilities to apply these skills.

**Course Contents:**

1. Introduction to quantitative reasoning
2. Overview of contributions of Mathematicians and Statisticians especially Muslim scholars.
3. Types of standard numbers
4. Proportions, rates, ratio and percentages
5. Odds and odds ratio
6. Scale of measurements
7. Number sequence and series
8. Unit analysis as a problem-solving tool
9. Data handling (small and large)
10. Data errors, absolute and relative and their applications
11. Descriptive statistics
12. Rules of counting: multiplication rule, factorial, permutation and combination
13. Probability and its application in real life
14. A graphical perspective through Venn Diagram
15. Financial indicator analysis, and money management (profit, loss, simple and compound interest)
16. Practical scenarios involving algebraic expressions: linear and quadratic

**Recommended Texts:**

1. Akar, G. K., Zembat, İ. Ö., Arslan, S., & Thompson, P. W. (2023). *Quantitative Reasoning in Mathematics and Science Education*. 1<sup>st</sup> Ed., Springer, USA.
2. Peck, R., Olsen, C., & Devore, J. L. (2015). *Introduction to statistics and data analysis*. 5<sup>th</sup> Ed., Brooks Cole, USA.
3. Devlin, K. J. (2012). *Introduction to mathematical thinking*. Palo Alto, CA: Keith Devlin.

**Suggested Readings:**

1. Triola, M. F., Goodman, W. M., Law, R., & Labute, G. (2006). *Elementary statistics*. Reading, MA: Pearson/Addison-Wesley.
2. Blitzer, R., & White, J. (2005). *Thinking mathematically*. Pearson Prentice Hall.

<b>Course Code</b>	<b>URCG-5127</b>	<b>Course Title</b>	<b>Seerat of the Holy Prophet (SAW)</b>	<b>Credit Hours</b>	<b>1(1-0)</b>
--------------------	------------------	---------------------	-----------------------------------------	---------------------	---------------

مطالعہ سیرت النبی صلی اللہ علیہ وسلم Secret of the Holy Prophet

Course Code

URCG - 5127

Title	Description
Semester	
Nature of Course	
No. of C.Hrs.	1(1-0)
Total Teaching weeks	18
Objectives of the Course	<p>۱۔ طلبہ کو مطالعہ سیرتِ نبویہ کی ضرورت و اہمیت سے آگاہ کرنا                  ۲۔ فقیر شخصیت میں مطالعہ سیرتِ نبویہ کے کردار کو واضح کرنا                  ۳۔ بیعت نبوی کے موقع پر اقامتِ ہمام کی عمومی صورت حال سے آگاہ کرنا                  ۴۔ رسول اکرم صلی اللہ علیہ وسلم کی سنی اور دینی زندگی کا اس طرح مطالعہ کرنا کہ طلبہ ان واقعات سے صحیح فائدہ حاصل کر سکیں                  ۵۔ طلبہ کو محمد نبوی کی معاشرت، سیاست و معیشت سے آگاہ کرنا</p>

Course Description

S.No.	Title	Description
1	حضور صلی اللہ علیہ وسلم کے ابتدائی حالات و زندگی	۱۔ حضور صلی اللہ علیہ وسلم کا تباری حسب و نسب ۲۔ پیدائش اور ابتدائی تربیت ۳۔ لاکھن اور حجازی کے حالات و زندگی
2	بیعت نبوی کے وقت و لاکھ حالات (۱)	۱۔ بیعت نبوی کے وقت اہم کردار ۲۔ حرب، معرکہ، پھیلنے و سامانی
3	بیعت نبوی	۱۔ سنی محمد میں دعوتِ اسلام
4	بیعت نبوی	۱۔ دینی محمد میں دعوتِ اسلام
5	مخاصص انجمنی	آپ بکھلے ہوئے ہوا ہوا ہوا
6	مخاصص انجمنی	بہشت استاد و معلم
7	مخاصص انجمنی	بہشت تاجر
8	مخاصص انجمنی	بہشت سربراہ و سیاست
9	مخاصص انجمنی	دینی جان اور عالمگیر اثرات

10	معاہدہ یافقی	تیسویں رسالت
11	اسوحت اور عمر حاضر	غیر مسلموں سے تعلقات
12	اسوحت اور عمر حاضر	اسوحت کی روشنی میں گھڑا زندگی
13	اسوحت اور عمر حاضر	مستشرقین اور مخالف ہیرت
15	اسوحت اور عمر حاضر	وطن سے محبت اور ہیرت
16	اسوحت اور عمر حاضر	مستشرقین کے اعتراضات اور ان کے جوابات

#### طہائی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	ابن ہشام	المسیر القشیری
2	مولانا شبلی نعمانی صاحب	میر تقی علی علیہ السلام
3	قاضی محمد سلیمان سلطان منصور پوری	رحمۃ اللعالمین
4	مولانا سید ابوالحسن علی ندوی	تذکرہ حضرت علی علیہ السلام
5	ڈاکٹر یحییٰ عظیم صمدی	مہم نبوی الاقام حکومت
6	ڈاکٹر خالد ندوی	الذین کان

#### عالمی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	سید ابوالاعلیٰ مودودی	ہیرت سرور عالم علی علیہ السلام
2	مولانا شبلی نعمانی صاحب	ابراہیم الخاتم
3	ڈاکٹر محمد کرم شاہ لاہوری	قیام تقی علی علیہ السلام
4	ڈاکٹر اکرم علیہ السلام	المسیر النبویہ الصحیحہ
5	مولانا سید ابوالاعلیٰ مودودی	ابراہیم

محمد علی

<b>Course Code</b>	ZOOL-5103	<b>Course Title</b>	Animal Diversity-II (Chordates)	<b>Credit Hours</b>	4(3-1)
--------------------	-----------	---------------------	------------------------------------	---------------------	--------

**Course Brief:**

This course will enable students to understand the taxonomic characteristics of protochordates and chordates. It provides knowledge about the phylogenetic relationships of protochordates and various classes of chordates. Students will understand the phylogenetic relations, physiological adaptations, behavior and diversity of Pisces, amphibians, reptiles and mammals and able to analyze the process of micro evolution within chordates. After this course the students will understand what the chordates are, can recognize different categories of chordates, understands the level of organization in chordate subphylum, can comprehend the general characters of chordates and know about the origin and evolutionary relationship in different subphylum of chordates.

**Course Learning Objectives:**

Upon successful completion of this subject students will be able to describe unique characters of urochordates, cephalochordates and fishes, can recognize difference in life functions of urochordates and fishes, will understand the ecological role of different groups of chordates and understand the diversity of chordates. Identification of the morphological and anatomical structure for the major groups of vertebrates from an evolutionary point of view will be discussed.

**Course Contents:**

1. Protochordates: classification of protochordates. Structure, anatomy and organ systems of acorn worms, urochordates and cephalochordates, reproduction; life histories and metamorphosis of protochordates. phylogenetic relationships.
2. Fishes: vertebrate success in water. Phylogenetic relationships of Pisces. Classification of Chondrichthyes, Osteichthyes, Dipnoi and Holocephalli. Locomotor adaptations, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development of Chondrichthyes (*Scoliodon*) and Osteichthyes (*Cyprinus carpio* and *Wallago attu*).
3. Amphibians: The first terrestrial vertebrates. Characteristics of amphibians Phylogenetic relationships. Classification of amphibians and characteristics of order Caudata, Gymnophiona, and Anura. Structure and locomotor adaptations, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and Osmoregulation, reproduction, development, and metamorphosis of caudate, anura and Gymnophiona.
4. Reptiles: The First Amniotes and cladistic interpretation of the amniotic lineage. General characteristics of reptiles. Characteristics of Order Testudines or Chelonia, Rhynchocephalia, Squamata, and Crocodylia. Adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory

functions, excretion and osmoregulation, reproduction and development of chelonia, squamata, Rhynchocephalia and crocodilian. Further phylogenetic considerations

5. Birds: Classification, feathers, flight and endothermy. Phylogenetic relationships; ancient birds and the evolution of flight. Diversity of modern birds. Adaptation in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and regulation, nervous and sensory systems, excretion and osmoregulation, reproduction and development. Migration and navigation.
6. Mammals: Classification, Specialized teeth, endothermy, hair and viviparity. Diversity of mammals. Adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, behavior, reproduction and development.

#### *Practical*

1. Classification and study of lab specimens of hemichordates, fishes, amphibians, reptiles, birds and mammals.
2. Visit to PMNH for the study of diversity of chordates.

#### **Recommended Texts:**

1. Miller, A. S., & Harley, J. P. (2016 & 2019). *Zoology* (10 & 11 ed.). Singapore: McGraw Hill.
2. Hickman, C. P., Roberts, L. S., Keen, S. L., Larson, A., l'Anson, H & Eisenhour., D. J. (2009). *Integrated principles of zoology* (14 ed.). Singapore: McGraw-Hill.
3. Hickman, C., Jr., Keen, S., Eisenhour, D., Larson, A. & l'Anson, H., (2019). *Integrated principles of zoology* (18 ed.). Singapore: McGraw-Hill.

#### **Suggested Readings:**

- Hickman, C. P., Roberts, L. S., & Larson, A. (2018). *Integrated principles of zoology* (15 ed.). Singapore: McGraw-Hill. th 1.
- Hickman, C., Jr., Keen, S., Eisenhour, D., Larson, A. & l'Anson, H., (2019). *Integrated principles of th zoology* (18ed.). Singapore: McGraw-Hill.
- Peckenik, J. A. (2015). *Biology of Invertebrates*. 7 Ed Singapore: McGraw-Hill.

<b>Course Code</b>	ZOOL-5104	<b>Course Title</b>	Animal Form and Function-II	<b>Credit Hours</b>	4(3+1)
--------------------	-----------	---------------------	-----------------------------	---------------------	--------

**Course Brief:**

This course will enable students to understand the diversity in animal form and function adapted according to the modified environmental conditions. Students will also be provided understanding about the need of emergence of diversity of forms for the performance of similar function in variable conditions. It also demonstrates that a form is successfully adapted to perform a function like temperature regulation adequately and successfully according to its own environment.

**Course Learning Objectives:**

Upon successful completion of course students will have knowledge about nutrition and digestion process among animal groups, temperature regulation strategies adapted by animals and different modes of reproduction adapted by several groups for their successful stay on planet. The practical section will let them to study the excretory system in invertebrate and vertebrate model animals, can study nutritive canal in invertebrate and vertebrate animals through dissection and will be able to study the male and female reproductive system of an invertebrate and a vertebrate animal model with familiarity of major differences in them.

**Course Contents:**

1. Nutrition and Digestion: Evolution of nutrition; the metabolic fates of nutrients in heterotrophs; digestion, Animal strategies for getting and using food, diversity in digestive structures of invertebrates., The mammalian digestive system: gastrointestinal motility and its control, Oral cavity, pharynx and esophagus, stomach, small intestine: main site of digestion; large intestine; role of the pancreas in digestion; and role of the liver and gallbladder in digestion.
2. Temperature and body fluid regulation: homeostasis and temperature regulation; the impact of temperature on animal life; heat gains and losses; some solutions to temperature fluctuations;
3. Temperature regulation in invertebrates, fishes, amphibians, reptiles, birds and mammals; heat production in birds and mammals, control of water and solutes (osmoregulation and excretion); invertebrate and vertebrate
4. Excretory systems; how vertebrates achieve osmoregulation; vertebrate kidney variations; mechanism in metanephric kidney functions.
5. Reproduction and development: asexual reproduction in invertebrates; advantages and disadvantages of asexual reproduction, sexual reproduction in invertebrates; advantages and disadvantages of sexual reproduction; sexual reproduction in vertebrates; reproductive strategies; examples of reproduction among various vertebrate classes; the human male reproductive system: spermatogenesis, transport and hormonal control, reproductive function; the human female reproductive system: folliculogenesis, transport and hormonal control, reproductive function; hormonal regulation in gestation; prenatal development and birth: the placenta; milk production and lactation.

***Practical***

1. Study of excretory system in an invertebrate and a vertebrate representative (Model).
2. Study of dissection system in invertebrate and a vertebrate representative (Dissection).
3. Dissection and study of male and female reproductive system in vertebrates and invertebrates.

*Note: Prepared slides and preserved specimen and/or projection slides and/or CD ROM computer projections may be used to develop better understanding among students.*

**Recommended Texts:**

1. Miller, A. S., & Harley, J. P. (2016 & 2019). *Zoology* (10 & 11 ed.). Singapore: McGraw Hill.
2. Hickman, C., Jr., Keen, S., Eisenhour, D., Larson, A., l'Anson, H., (2019). *Integrated principles of zoology* (18 ed.). Singapore: McGraw-Hill.

**Suggested Readings:**

1. Campbell, N. A. (2002). *Biology* (6<sup>th</sup> ed.). California: Benjamin Cummings.
2. Kent, G. C., & Miller, S. (2001). *Comparative anatomy of vertebrates*. New York: McGraw-Hill.
3. Pechenik, J. A. (2015). *Biology of invertebrates* (7<sup>th</sup> ed.). Singapore: McGraw-Hill

## SEMESTER III

Course Code	URCG- 5119	Course Title	Expository Writing	Credit Hours	3 (3-0)
-------------	------------	--------------	--------------------	--------------	---------

### Course Brief:

This course prepares undergraduates to become successful writers and readers of English. The course helps students develop their fundamental language skills with a focus on writing so that they can gain the confidence to communicate in oral and written English outside the classroom. The course is divided into five units and takes a Project-based Learning approach. Unit themes target the development of 21<sup>st</sup> century skills and focus on selfreflection and active community engagement.

### Course Learning Objectives:

The course completion will enable the students to develop communication skills as reflective and selfdirected learners. They will be able to intellectually engage with different stages of writing process, and develop analytical and problem-solving skills to address various community-specific challenges.

### Course Contents:

1. Self-Reflection
  - Introduction to the basics of the writing process
  - Introduction to the steps of essay writing
  - Prewriting activities: Brainstorming, listing, clustering and freewriting
  - Practicing Outlining of the essay
2. Personalized Learning
  - Learning Process, Learning Styles, Goal Setting and Learning Plan
3. Oral Presentation
  - Structure and Significance, Content Selection and Slide Presentation, Peer Review
4. Critical Reading Skills
  - Introducing Authentic Reading (Dawn and non-specialist academic books/texts)
  - Reading Strategies and Practice: Skimming, scanning, SQW3R, Annotating, Detailed reading and note-taking, Standard Test Practice: TOEFL and IELTS, Model Review Reports and Annotated Bibliographies
5. Community Engagement
  - Student-led brainstorming on local versus global issues, Identifying research problems
  - Drafting research questions, Drafting interview/survey questions for community research (in English or L1)
  - Engaging students in Critical reading, Presenting interview/ survey information, Field work
  - Writing Community Engagement Project
6. Letter to the Editor
  - Types of letters, Format and purpose of letter to the editor, Steps in writing letter-to-editor

**Recommended Texts:**

1. Bailey, S. (2011). *Academic writing: A handbook for international students* (3rd ed.). New York: Routledge.
2. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3<sup>rd</sup> ed.). Ann Arbor: The University of Michigan Press.

**Suggested Readings:**

1. Cresswell, G. (2004). *Writing for academic success*. London: SAGE.
2. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
3. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association.

<b>Course Code</b>	URCG-5121	<b>Course Title</b>	Tools for Quantitative Reasoning	<b>Credit Hours</b>	3(3-0)
--------------------	-----------	---------------------	-------------------------------------	---------------------	--------

**Course Brief:**

This course is based on quantitative reasoning 1 course. It will enhance the quantitative reasoning skills learned in quantitative reasoning 1 course. Students will be introduced to more tools necessary for quantitative reasoning skills to live in the fast paced 21st century. Students will be introduced to importance of statistical and mathematical skills in different professional settings, social and natural sciences. These quantitative reasoning skills will help students to better participate in national and international issues like political and health issues

**Course Learning Objectives:**

This course will prepare the students to apply quantitative reasoning tools more efficiently in their professional and daily life activities. This course will help them to better understand the information in form of numeric, graphs, tables, and functions.

**Course Contents:**

1. Types of data and its graphical representation ( Histogram, Stem and Leaf display, Box Plot, Scatter diagram, Histogram, Bar chart, etc)
2. Solving practical problems using linear and exponential models
3. Population growth models
4. Analytical approach to solve simultaneous equations
5. Inequalities and their application
6. Comparing quantities using analytical tools
7. Logical reasoning and their application in modern age
8. Logical reasoning and decision making
9. Data tendencies via measure of location
10. Variability and Measure of dispersion
11. Measuring relationships via Regression analysis and correlation
12. Statistical inference: sampling techniques, estimation techniques and hypothesis testing for decision and policy making

**Recommended Texts:**

1. Akar, G. K., Zembat, İ. Ö., Arslan, S., & Thompson, P. W. (2023). *Quantitative Reasoning in Mathematics and Science Education*. 1<sup>st</sup> Ed., Springer, USA.
2. Sharma, A. K. (2005). *Text book of elementary statistics*. Discovery Publishing House.
3. Blitzer, R. (2014). *Precalculus*, 5<sup>th</sup> Ed.. Pearson Education, Limited. New York

**Suggested Readings:**

1. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of mathematical statistics*. 12<sup>th</sup> Ed, Sultan Chand & Sons.
2. Aufmann, R. N., Lockwood, J., Nation, R. D., & Clegg, D. K. (2007). *Mathematical thinking and quantitative reasoning*. Cengage Learning
3. Blitzer, R., & White, J. (2005). *Thinking mathematically*. Pearson Prentice Hall.

<b>Course Code</b>	URCG-5122	<b>Course Title</b>	Ideology and Constitution of Pakistan	<b>Credit Hours</b>	2(2-0)
--------------------	-----------	---------------------	---------------------------------------	---------------------	--------

**Course Brief:**

This course focuses on ideological background of Pakistan. The course is designed to give a comprehensive insight about the constitutional developments of Pakistan. Starting from the Government of India Act, 1935 till to date, all important events leading to constitutional developments in Pakistan will be the focus of course. Failure of the constitutional machinery and leading constitutional cases on the subject. Moreover, students will study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

**Course Learning Objectives:**

It will also cover the entire Constitution of Pakistan 1973. However, emphasis would be on the fundamental rights, the nature of federalism under the constitution, distribution of powers, the rights and various remedies, the supremacy of parliament and the independence of judiciary.

**Course Contents:**

- **Ideology of Pakistan**  
  - Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
  - Two Nation Theory and Factors leading to Muslim separatism.
- **Constitutional Developments**  
  - Salient Feature of the Government of India Act 1935 Salient Feature of Indian Independence Act 1947 Objectives Resolution
  - Salient Feature of the 1956 Constitution
  - Developments leading to the abrogation of Constitution of 1956 Salient features of the 1962 Constitution
  - Causes of failure of the Constitution of 1962
  - Comparative study of significant features of the Constitution of 1956, 1962 and 1973
- **Fundamental rights**
- **Principles of policy**
- **Federation of Pakistan** President Parliament The Federal Government
- **Provinces**  
  - Governors
  - Provincial Assemblies
  - The Provincial Government
- **The Judicature**  
  - Supreme Court High Courts

**Federal Shariat Courts Supreme Judicial Council**

**Administrative Courts and tribunals**

- **Islamic Provisions in Constitution**
- **Significant Amendments of Constitution of Pakistan 1973**

**Recommended Texts:**

1. Constitutional and Political History of Pakistan by Hamid Khan
2. Mahmood, Shaukat and Shaukat, Nadeem. Constitution of the Islamic Republic of Pakistan, 3rd re edn. Lahore: Legal Research Centre, 1996.
3. Munir, Muhammad. Constitution of the Islamic Republic of Pakistan: Being a Commentary on the Constitution of Pakistan, 1973. Lahore, Law Pub., 1975

**Suggested Readings:**

1. Rizvi, Syed Shabbar Raza. Constitutional Law of Pakistan: Text, Case Law and Analytical Commentary. 2nd re edn. Lahore: Vanguard, 2005.
2. The Text of the Constitution of the Islamic Republic of Pakistan, 1973 (as amended).

<b>Course Code</b>	URCG-5111	<b>Course Title</b>	Translation of the Holy Quran- II	<b>Credit Hours</b>	<b>Non-Credit</b>
--------------------	-----------	---------------------	-----------------------------------	---------------------	-------------------

**Course Brief:**

- Students will come to know about the real nature, significance and relevance of the Islamic beliefs in light of the text of the Holy Quran.
- Students will seek knowledge of translation and transliteration of the Holy Book Quran.
- To familiarize the students with the concept of Ibādah (Its significance, scope and relevance) and its types in Islam.
- Students will learn literal and idiomatic way of translation of the Holy Book.
- Students will learn about the polytheism and its incompatibility in Islam highlighted by the Holy Quran

**Course Learning Objectives:**

- To highlight the significance of learning through using all human faculties provided by the almighty Allah and familiarize the students about condemnation of ignorance mentioned in the Quranic text.
- To develop Awareness among the students about rights and duties of different circles of society in the light of Holy Quran.

To introduce the students to Quranic Arabic grammar in practical manner.

<p>Course Contents:</p>	<p>○ ایمانیات اور عبادات</p> <p>بلا پر ایمان، فرشتوں پر ایمان، رسولوں پر ایمان، آسمانی کتابوں پر ایمان یوم آخرت پر ایمان، تقدیر پر ایمان نماز، روزہ، زکوٰۃ، حج، جہاد</p> <p>○ معاشرے کے حقوق</p> <p>خاندان کی تکوین - حق مہر</p> <p>رضاعت و حمل</p> <p>اولاد کو قتل کرنے کے ممانعت</p> <p>شوہر کی نافرمانی - طلاق</p> <p>بیوہ کی عدت کے احکام</p> <p>نکاح کا پیغام بھیجنا</p> <p>عورت کی وراثت (اس کے شوہر کی طرف سے)</p> <p>والدین کے حقوق - بیویوں اور اولاد کے بیچ</p> <p>عداوت ○ خاندان کے حقوق</p> <p>مہمان کی عزت</p> <p>اجازت طلب کرنے کے اصول</p> <p>مجلس کے اداب</p> <p>تعاون اور بھائی چارہ - گروہ بندی</p> <p>محبت</p> <p>لوگوں کے درمیان صلح</p> <p>عفو و درگزر، غصہ پر قابو اور معاف کرنا</p> <p>شعوب و قبائل - لوگوں کے بیچ اختلافات</p>
	<p>○ حمایت و نگہبانی</p>
<p>Grammar:</p>	<p>قرآنی عربی گرامر کے اصول اور انکے اطلاقات (متن قرآنی پر اطلاق سے توضیحات)</p>

<p>Details of Chapters and verse Numbers:</p>	<p>منتخب آيات مع ترجمه وتجويد</p> <p>البقره (( ١١٧، ٢٣٨، ٤٥، ١١٨، ٢٧٨، ١٧٧، ٤٥، ٣٤٧، ١٥٨، ٧١٨، ٤٢٨، ٥٣، ٤٢٨، ٤٧، ٢٨٧، ٣٤٨، ٢٢، ٨٢، ٢٨٧، ٤٢٨، ٢٢٨، ١١٧، ٢٣٧، ٢٢٧، ١١٨، ٥٢٧، ٣٢٧، ٢٧٨، ٢٤٧، ١٨٨، ٧٥٨، ٢٢٧، ٢٢٧، ١٢٨، ٤٢٨، ١٢٨، ٧٣٨، ٢٨٨، ٢٨٨، ١٢٨، ٢٨٨، ١٨٨، ٧٥٨، ٢٢٧، ٢٤٧، ٢٧٨، ٨٢، ٥٢٧، ٣٣٨، ٨٢٧، ١٢٧، ٣٢٢)</p> <p>النساء (( ٤٢، ٨٢، ٢٤، ٢٣٧، ٢٢، ١٢، ٣٧، ٢٢، ١٢، ٢٢، ٢٣، ٢١٧، ٢٣، ٨٧، ٤٣، ٢٨٧، ٥٣، ٧٧، ٥، ٢١٧، ٥٨، ٤٨، ٧٧، ٧٧، ٢٨٧، ٧٢٧، ٤٣، ١٨، ٤٣، ٧٢٧، ٢، ٧، ١٨، ٧، ٢٧، ٢٥٧، ٥٤، ٢٨٧، ٧٢)</p> <p>النعام (( ٨٨، ١٣٧، ٥٧، ٨٢، ٧٤٧، ٢٥، ٥٤) ال عمران (( ١٢، ٢٣، ٤٢، ٤٨٧، ٥٢، ٥٥٧، ٧، ٢٧) المائدة (( ٨، ٨٢، ٢٣، ٢٧، ٨، ٤) العراف (( ٢٢٧، ٢٢٧، ٤٣) التوبه (( ١٨، ٢٧، ٧١) الزمر (( ٢، ٨٧) النور (( ٥٤، ٨٤، ٢٨، ١٨، ١٢، ٢٨) محمد (( ٣٣) انفال (( ٨٢، ١٨) الرعد (( ٣) الطارق (( ٥) الحج (( ٤) ابراهيم (( ٢٨، ٥٥) السراء (( ٣٨، ٥٨) الحقاف (( ٤٧) المومنون (( ١٨) العنكبوت (( ٢٥، ٤٨، ٢) النحل (( ٨٨) لقمان (( ٤٧، ٥) الحزاب (( ١٤، ٢٣، ٤٣) الشعراء (( ١) الروم (( ٧٨) مريم (( ٢٨، ٥٧) المجادلة (( ٧٧، ٨٧)</p>
-----------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<b>Course Code</b>	ZOOL-5105	<b>Course Title</b>	Economic Zoology	<b>Credit Hours</b>	3(2-1)
--------------------	-----------	---------------------	------------------	---------------------	--------

**Course Brief:**

The course will enable students to learn about the relationship of commerce with domestic animals, their products, by-products and associated farming practices. They will also learn about the importance of human and domestic animal diseases and their vital relation to the economy. This course also provides knowledge about internal and external parasites and their effects on domestic animals and their farming practices. It also familiarizes the students with the value of studying various general practices, principles and techniques in farming and rearing of animals in sericulture (silk worms), apiculture (honey bees), aquaculture (fisheries, pearl culture, prawns and oysters), poultry (domestic fowl and ostriches) and cattle husbandry

**Course Learning Objectives:**

Students will acquire basic knowledge of commerce and economics in relation to Zoology. Economic zoology imparts knowledge about application of zoological knowledge for the benefit of mankind which mainly includes culturing animals for mass production for human use and to control or eradicate animals that are injurious to man directly or indirectly.

**Course Contents:**

1. Basic concepts in Economic Zoology.
2. Parasitic protozoans and human disease.
3. Economic importance of protozoa.
4. Vectors of human and domestic animals.
5. Ecto- and endo-parasites of fish, poultry, cattle and Man (Crustacea, Helminthes and Arachnida).
6. Pests of pulse crops. Pests of oil seed crops, stored grain pests, pests of cotton, vegetables, fruits and tea.
7. Apiculture, and sericulture, lac insect culture and pearl culture
8. Aquaculture and fisheries (edible fresh water, pond and marine fish, prawns, pearl oysters).  
economic importance of fishes
9. Bird farming (poultry, quail, turkey, ostrich and pigeon).

*Practical*

1. To study the prepared slides of various types of ecto- and endo-parasites. 2. To observe and study museum specimens of vertebrate and invertebrate,
3. Pests of important crops and stored grains in Pakistan.
4. To visit Honey Bee farm. Write a report on their observations.
5. Visit to Sericulture farm in a nearby locality and write report on their observations.
6. Study visit to fish hatchery, nursery ponds, stocking ponds, commercial fish breeding farms.
7. Report writing.
8. Identification of important species of Fish and their natural animal.

9. Visit to any bird farm and write a report on their observations.

**Recommended Texts:**

1. Ravindranathan, K. R. (2003). *Economic zoology* (1<sup>st</sup>ed.). New Delhi, India: Dominant Publishers and Distributers.
2. Primack, R. B. (2000). *A Primer of conservation of biology* (2<sup>nd</sup>ed.). Massachusetts: Sinauer Associates.

**Suggested Readings:**

1. Mirza, Z. B. (1998). *Animal biodiversity of Pakistan* (1<sup>st</sup>ed.). Rawalpindi: Printopack.
2. Akhtar, M., & Muzaffar, N. (2008). *Introduction to apiculture*. Lahore: Punjab University Press.
3. Blackiston, H. (2001). *Beekeeping for dummies*. Indiana: Wiley Publishing.

<b>Course Code</b>	ZOOL-5106	<b>Course Title</b>	Cell and Molecular Biology	<b>Credit Hours</b>	4(3-1)
--------------------	-----------	---------------------	----------------------------	---------------------	--------

**Course Brief:**

The course aims to impart knowledge about the animal cell and its complex organization and architecture. It enables students to understand various ultra-structural, molecular and functional aspects of the cells. Students will be able to describe and discuss the properties and biological significance of the major classes of molecules found in living organisms and the relationship between molecular structure and biological function, can relate how cell movement and cell-cell communication occur and discuss mechanisms of signal transduction and the lab work will provide platform to become familiar with various cell types through techniques of slide preparation.

**Course Learning Objectives:**

Understanding of microscopy to study cell structure and cellular compartmentalization will be provided to learners. Main emphasis of course is to develop familiarity with structure and function of cells at the molecular level, including the flow of information from genes to proteins, and regulation of cellular processes, signaling and proliferation in eukaryotic cells.

**Course Contents:**

1. Introduction to prokaryotic and eukaryotic cells: plasma membrane, its chemical composition structure and functions of plasma membranes, cell permeability, active transport, endocytosis, phagocytosis.
2. Cytoskeleton: microfilaments, microtubules, intermediate filaments.
3. Cytoplasmic Organelles: Membrane system, structural and functional commonalities.
4. Ultrastructure, chemical composition and functions of endoplasmic reticulum and their role in protein synthesis and drug metabolism, golgi apparatus its role in synthesis of glycoprotein,
5. Mitochondrial respiration and its significance as semi- autonomous organelle;
6. Lysosome, its diverse roles due to hydrolytic activity of enzymes, Peroxisome, its role in metabolism of hydrogen peroxide, glyoxysome with reference to glyoxylic acid cycle.
7. Nucleus: chromatin, heterochromatin, euchromatin, chromosome structure,coiling and nucleosome during different phases of cell cycle.
8. Replication: mechanism, DNA replication in prokaryotes specially withreference to variety of DNA polymerases and other proteins involved, DNA replication in eukaryotes with emphasis on DNA polymerases, concept of replicons etc.,
9. Transcription: variety of RNA and their characteristics, synthesis of mRNA, rRNA and tRNA with special reference to enzymes involved, RNA splicing, split genes, concept of ribozymes and Post transcriptional processing, RNA transduction, Genetic code, point mutations.
10. Translation: specific role of ribosomes, various factors, andposttranslational processing, control of gene expression in Prokaryotes.

*Practical*

1. Preparation of whole mount.
2. Preparation of human blood smear and identification of Leucocytes.

3. Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone).
4. Squash preparation of onion root tip for mitotic stages
5. Mounting of polytene chromosome (*Drosophila*/Chironomous.) Demonstration.
8. Cultural and staining of bacteria.

**Recommended Texts:**

1. Cooper, G. M., & Adams, K. (2022). *The cell: A molecular approach* (9<sup>th</sup> ed.). Massachusetts: Sinauer Associates.
2. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Martin, K. C., Yaffe, M., & Amon, A. (2021). *Molecular cell biology* (9<sup>th</sup> ed.). New York: W. H. Freeman.
3. Karp, G., Iwasa, J., & Marshall, W. (2020). *Karp's cell and molecular biology: concepts and experiments* (9<sup>th</sup> ed.). New Jersey: John Wiley and Sons.

**Suggested Readings:**

1. De-Robertis, E. D. (2014). *Cell and molecular biology* (8<sup>th</sup> ed.). New York: Lea & Febiger.
2. Alberts, B., Hopkin, H., Johnson, A., Morgan, D., Walter, P., & Heald, R. (2023). *Essential cell Biology* (6<sup>th</sup> ed.). New York: W. W. Norton & Company.
3. Hofmann, A., & Clokie, S. (2018). *Wilson and Walker's principles and techniques of Biochemistry and molecular biology* (8<sup>th</sup> ed.). Cambridge: Cambridge University Press.

<b>Course Code</b>	CHEM-5101	<b>Course Title</b>	Inorganic Chemistry	<b>Credit Hours</b>	4(3-1)
--------------------	-----------	---------------------	---------------------	---------------------	--------

**Course Brief:**

This course covers a range of general topics of inorganic chemistry. It will provide a useful supplement to the advanced courses specified in the department. This course aims to enable the students to achieve the advance knowledge about the key introductory concepts of chemical bonding, acid-base chemistry, and properties of the representative and transition elements, as well as using this knowledge for qualitative and quantitative analysis of inorganic compounds during laboratory work.

**Course Learning Objectives:**

It develops critical thinking skills enabling students to solve chemistry problems that incorporate their cumulative knowledge. Students learned in class to modern chemistry techniques which give them opportunities to upgrade their knowledge about advanced inorganic concepts. The essence of this course is to develop study skills that students need to succeed in university-level chemistry courses and preparation of students for professional positions in chemistry.

**Course Contents:**

1. Periodic Table and Periodicity of Properties: Modern Periodic Table, Group trends and periodic properties, Atomic & ionic radii, ionization potentials, electron affinities and electronegativities; Redox potential, electrochemical series and its applications. Corrosion and electroplating.
2. Acid Base Equilibria: Acids and bases, relative strengths of acids, pH, pKa, pKb. Hard and soft acid & Bases. SHAB Principle & its application. Buffers, types buffer, Preparation, Buffer capacity and applications of buffers. Indicators: (Acid-base, Redox, Adsorption), Solubility product, Common ion effect and its applications.
3. Chemical Bonding: Nature of a bond, hybridization, Valence Bond Theory (VBT), The Concept of Resonance, Molecular Orbital Theory (MOT), Valence Shell Electron Pair Repulsion (VSEPR) theory. Special types of bonds such as Metallic bonds, Hydrogen Bonding, Bent bond, Ion-dipole- dipole bond, ion induced-dipole bond.
4. Chemistry of p-Block Elements: Introduction to p-block elements (Group trends in p-block elements with reference to, atomic sizes & chemical reactivities). Boranes & Boride; aluminium halides, hydrides & Alums; Silicates (Structural aspects, classifications and applications); silicones (Structural aspects, classifications and applications), Germanes; phosphazenes, Phosphides, Oxoacids of Phosphorous; Oxoacids & salts of sulphur; Noble gases (compounds of Xe, Kr, Ra; bonding and applications). Production of pure silicon chips for solar energy cells.
5. Chemistry of d-Block Elements: Electronic configuration. Characteristics. Nomenclature. Nature of bonding in coordination compounds: Werner's theory, VBT, MOT and CFT for coordination compounds. Isomerism in coordination compounds. Chelates: Classification and applications. Applications of coordination compounds (Medicinal, Industrial, Agricultural).
6. Separation Techniques: General introduction and Applications (Solvent extraction and Chromatographic techniques such as paper, Ion exchange and Column).
7. Introduction to Analytical Techniques in Inorganic Chemistry: Introduction to spectroscopic Techniques: Principle, brief instrumentation, sample handling and applications (Flame emission, Atomic Absorption, IR & UV/Vis).

8. Chemical Industries: Metallurgy of Al, Cr and U, fertilizers (Urea & Phosphate fertilizers) Cement and Sugar.

### *Practical*

1. Qualitative Analysis; four radicals (cations and anions) for salt mixture.
2. Chromatographic separation of cations
3. Determination of total hardness of water using EDTA.
4. Estimation of manganese (II) using EDTA.
5. Estimation of copper (Iodometrically).
6. Determination of thiosulphate ion (Iodometrically).
7. Determination of ferricyanide using KI solution.
8. Determination of chloride by Volhard's and Mohr's methods.
9. Estimation of chloride ions using adsorption (Fluorescein) indicator.
10. Estimation of bromide ions using adsorption (Eosin) indicator.
11. Estimation of percentage of ferrous ions in the Mohr's salt using  $\text{KMnO}_4$ .
12. Percentage determination of ferric ions in ferric alum using  $\text{KMnO}_4$  solution.
13. Determination of purity of commercial potassium oxalate using  $\text{KMnO}_4$  solution.
14. Estimation of ferrous ions using  $\text{K}_2\text{Cr}_2\text{O}_7$  solution.

### **Recommended Texts:**

1. Iqbal, M.Z. (2015). *Textbook of inorganic chemistry* (Revised edition). Lahore: IlmiKitabKhana.
2. Lee, J.D. (1996). *Concise inorganic chemistry* (5<sup>th</sup>ed.). London: Chapman & Hall.
3. Vogel, A.I. (1995). *A textbook of macro and semi micro qualitative inorganic analysis*. New York: Longman Green & Co.
4. Skoog, D.A., West, D.M., & Holler, F.J. (1994). *Analytical chemistry* (6<sup>th</sup>ed.). Philadelphia: Saunders College Publications.

### **Suggested Readings:**

1. Graham, H., & Man, H. (2000). *Chemistry in context* (5<sup>th</sup>ed.). Nashville: Thomas Nelson Ltd.
2. Philp, M. (1996). *Advance chemistry*. Cambridge: Cambridge University Press.
3. David, H. (2000). *Modern analytical chemistry*. New York: McGraw Hill

## Semester IV

<b>Course Code</b>	URCG-5115	<b>Course Title</b>	The Science of Global Challenges	<b>Credit Hours</b>	3(2-1)
--------------------	-----------	---------------------	----------------------------------	---------------------	--------

### Course Brief:

Natural sciences enable an understanding and appreciation of the physical and the natural world through observation and experimentation. The program of studies introduces students to theoretical analyses, experimental methods, and problem solving. The study of physics, chemistry, geology, biology, and ecology helps develop critical faculties for evaluating natural phenomena and expert opinion.

### Course Learning Objectives:

The course shall enable the students to practice application of Scientific Method in the natural sciences. It will also teach the students to appreciate the beauty of the natural and physical worlds often hidden from casual observation but which, once revealed, lends richness to everyday life.

### Course Contents:

**Climate Change** i.e., Global Warming, Natural and Anthropogenic Activities and their impact;

**Energy** i.e., Renewable and non-renewable energy resources; **Water Security** i.e., water scarcity and waste water treatment; **Land Degradation** i.e., salinity, water logging, deforestation, land erosion; **Food Security** and roll of Biotechnology in food production; **Global Health Pandemics** i.e., Infectious diseases, vaccine, development of drug discovery for newly explored diseases

### **Practical:**

1: Preparation of standard solution and their standardizations

2: Soil and Water Analysis

### Recommended Texts:

1. Usman, M. (2022). *Science of Global Challenges*. Ilmi Kitab Khana, Lahore

### Suggested Readings:

1. Thieman, W.J. & Palladino, M.A. (2014). *Introduction to biotechnology*. Edinburgh Gate UK: Pearson Education Limited.
2. Daugherty, E. (2012). *Biotechnology: Science for the New Millennium*, 1st Edition, Revised, USA: Paradigm Publication.
3. Karaduman, I. C. (Ed.) (2014) *Global Challenges for the world*. Obroonnosc. Zeszytl Naukowe. Turkey

<b>Course Code</b>	URCG-5124	<b>Course Title</b>	Entrepreneurship	<b>Credit Hours</b>	2(2-0)
--------------------	-----------	---------------------	------------------	---------------------	--------

**Course Brief:**

This course addresses the unique entrepreneurial experience of conceiving, evaluating, creating, managing, and potentially selling a business idea. The goal is to provide a solid background with practical application of important concepts applicable to the entrepreneurial environment. Entrepreneurial discussions regarding the key business areas of finance, accounting, marketing and management include the creative aspects of entrepreneurship. The course relies on classroom discussion, participation, the creation of a feasibility plan, and building a business plan to develop a comprehensive strategy for launching and managing a new venture.

**Course Learning Objectives:**

1. To enhance the 'entrepreneurial intentions' of the students by improving their natural willingness to start a business.
2. To understand the process of entrepreneurship and learn the ways to manage it by working individually in the class and in the form of groups outside the class to conduct field assignments.
3. To educate the students about the practical underpinnings of the entrepreneurship with the aid of practical assignments and idea pitching

**Course Contents:**

1. **Background:** What is an Organization, Organizational Resources, Management Functions, Kinds of Managers, Mintzberg's Managerial Roles.
2. **Forms of Business Ownership:** The Sole proprietorship, Partnership, Joint Stock Company
3. **Entrepreneurship:** The World of the Entrepreneur, what is an entrepreneur? The Benefits of Entrepreneurship, The Potential Drawbacks of Entrepreneurship, Behind the Boom: Feeding the Entrepreneurial Fire.
4. **The Challenges of Entrepreneurship:** The Cultural Diversity in Entrepreneurship, The Power of "Small" Business, Putting Failure into Perspective, The Ten Deadly Mistakes of Entrepreneurship, How to Avoid the Pitfalls, Idea Discussions & Selection of student Projects, Islamic Ethics of Entrepreneurship.
5. **Inside the Entrepreneurial Mind:** From Ideas to Reality: Creativity, Innovation, and Entrepreneurship, Creativity – Essential to Survival, Creative Thinking, Barriers to Creativity, How to Enhance Creativity, The Creative Process, Techniques for Improving the Creative Process, Protecting Your Ideas, Idea Discussions & Selection of student Projects.
6. **Products and technology, identification opportunities**
7. **Designing a Competitive Business Model and Building a Solid Strategic Plan:** Building a strategic plan, Building a Competitive Advantage, The Strategic Management Process, Formulate strategic options and select the appropriate strategies, Discussion about execution of Students' Project.
8. **Conducting a Feasibility Analysis and Crafting a Winning Business Plan:** Conducting a Feasibility Analysis, Industry and market feasibility, Porter's five forces model, Financial feasibility analysis. Why Develop a Business Plan, The Elements of a Business Plan, What Lenders and Investors Look for in a Business Plan, Making the Business Plan Presentation.

9. **Building a Powerful Marketing Plan:** Building a Guerrilla Marketing Plan, Pinpointing the Target Market, Determining Customer Needs and Wants Through Market Research. Plotting a Guerrilla Marketing Strategy: How to Build a Competitive Edge, Feed Back & Suggestions on Student Project, Islamic Ethics for Entrepreneurial Marketing
10. **E-Commerce and the Entrepreneur:** Factors to Consider before Launching into E-Commerce, Ten Myths of E-Commerce, Strategies for E-Success, Designing a Killer Web Site, Tracking Web Results, Ensuring Web Privacy and Security, Feed Back & Suggestions on Student Project.
11. **Pricing Strategies:** Three Potent Forces: Image, Competition, and Value, Pricing Strategies and Tactics, Pricing Strategies and Methods for Retailers, The Impact of Credit on Pricing
12. **Attracting Venture Capitalist:** Projected Financial Statements, Basic Financial Statements, Ratio Analysis, Interpreting Business Ratios, Breakeven Analysis, Feed Back & Suggestions on Student Project,
13. **Idea Pitching:** Formal presentation, 5-minutes pitch, funding negotiation and launching.

**Recommended Texts:**

Scarborough, N. M. (2011). *Essentials of entrepreneurship and small business management*. Publishing as Prentice Hall, One Lake Street, Upper Saddle River, New Jersey 07458.

**Suggested Readings:**

Burstiner, I. (1989). *Small business handbook*. Prentice Hall Press.

<b>Course Code</b>	URCG-5125	<b>Course Title</b>	Civics and Community Engagement	<b>Credit Hours</b>	2(2-0)
--------------------	-----------	---------------------	---------------------------------	---------------------	--------

**Course Brief:**

The Civics and Community Engagement course is designed to provide students with an understanding of the importance of civic participation, culture and cultural diversity, basic foundations of citizenship, group identities and the role of individuals in creating positive change within their communities. The course aims at developing students' knowledge, skills and attitudes necessary for active and responsible citizenship

**Course Learning Objectives:**

After completing this course, students will be able to

- Understand the concepts of civic engagement, community development, and social responsibility.
- Understand rights and responsibilities of citizenship
- Understand cultural diversity in local and global context
- Analyze the significance of civic participation in promoting social justice, equity, and • democracy.
- Examine the historical and contemporary examples of successful civic and community engagement initiatives.
- Identify and assess community needs, assets, and challenges to develop effective strategies for community improvement.
- Explore the ethical implications and dilemmas associated with civic and community engagement.
- Develop practical skills for effective community organizing, advocacy, and leadership.
- Foster intercultural competence and respect for diversity in community engagement efforts.
- Collaborate with community organizations, stakeholders, and fellow students to design and implement community-based projects.

**Course Contents:**

**Introduction to Civics & Community Engagement**

- Overview of the course: Civics & Community Engagement□
- Definition and importance of civics□
- Key concepts in civics: citizenship, democracy, governance, and the rule of law□
- Rights and responsibilities of citizens□

**Citizenship and Community Engagement**

- Introduction to Active Citizenship: Overview of the Ideas, Concepts, Philosophy and Skills□
- Approaches and Methodology for Active Citizenship□

**Identity, Culture, and Social Harmony**

- Concept and Development of Identity, Group identities□
- Components of Culture, Cultural pluralism, Multiculturalism, Cultural Ethnocentrism, Cultural relativism, Understanding cultural diversity, Globalization and Culture, Social Harmony,□

- Religious Diversity (Understanding and affirmation of similarities & differences)□
- Understanding Socio-Political Polarization□
- Minorities, Social Inclusion, Affirmative actions□

#### **Multi-cultural society and inter-cultural dialogue**

- Inter-cultural dialogue (bridging the differences, promoting harmony)□
- Promoting intergroup contact/ Dialogue□
- Significance of diversity and its impact□
- Importance and domains of Inter-cultural dialogue□

#### **Active Citizen: Locally Active, Globally Connected**

- Importance of active citizenship at national and global level□
- Understanding community□
- Identification of resources (human, natural and others)□
- Utilization of resources for development (community participation)□
- Strategic planning, for development (community linkages and mobilization)□

#### **Human rights, constitutionalism and citizens' responsibilities**

- Introduction to Human Rights□
- Human rights in constitution of Pakistan□
- Public duties and responsibilities□
- Constitutionalism and democratic process□

#### **Social Institutions, Social Groups, Formal Organizations and Bureaucracy**

- Types of Groups, Group identities, Organizations□
- Bureaucracy, Weber's model of Bureaucracy□
- Role of political parties, interest groups, and non-governmental organizations□

#### **Civic Engagement Strategies**

- Grassroots organizing and community mobilization
- Advocacy and lobbying for policy change
- Volunteerism and service-learning opportunities **Social issues/Problems of Pakistan**

□ Overview of major social issues of Pakistani society□ **Social Action Project**

#### **Recommended Texts:**

1. Kennedy, J. K., & Brunold, A. (2016). Regional context and Citizenship education in Asia and Europe. New Yourk: Routledge, Falmer.
2. Henslin, James M. (2018). Essentials of Sociology: A Down to Earth Approach (13<sup>th</sup> ed.). New York: Pearson Education
3. Macionis, J. J., & Gerber, M.L. (2020). Sociology. New York: Pearson Education

#### **Suggested Readings:**

1. Glencoe McGraw-Hill. (n.d.). Civics Today: Citizenship, Economics, and Youth.
2. Magleby, D. B., Light, P. C., & Nemacheck, C. L. (2020). Government by the People (16th ed.). Pearson.
3. Sirianni, C., & Friedland, L. (2005). The Civic Renewal Movement: Community-Building and Democracy in the United States. Kettering Foundation Press.

4. Bloemraad, I. (2006). *Becoming a Citizen: Incorporating Immigrants and Refugees in the United States and Canada*. University of California Press.
5. Kuyek, J. (2007). *Community Organizing: Theory and Practice*. Fernwood Publishing.
6. DeKieffer, D. E. (2010). *The Citizen's Guide to Lobbying Congress*. TheCapitol.Net.
7. Rybacki, K. C., & Rybacki, D. J. (2021). *Advocacy and Opposition: An Introduction to Argumentation* (8th ed.). Routledge.
8. Kretzmann, J. P., & McKnight, J. L. (1993). *Building Communities from the Inside Out: A Path Towards Finding and Mobilizing a Community's Assets*. ACTA Publications.
9. Patterson, T. E. (2005). *Engaging the Public: How Government and the Media Can Reinvigorate American Democracy*. Oxford University Press.
10. Love, N. S., & Mattern, M. (2005). *Doing Democracy: Activist Art and Cultural Politics*.

<b>Course Code</b>	ZOOL-5107	<b>Course Title</b>	Biochemistry	<b>Credit Hours</b>	4(3-1)
--------------------	-----------	---------------------	--------------	---------------------	--------

**Course Brief:**

The course aims to provide in-depth knowledge about the polymerized organic compounds of life. It will develop an understanding about the dynamism in life as it proceeds with inter-conversion of the chemicals from feeding to the liberation of energy for work. It enables students to know how organisms harvest energy for growth and duplication. This course will help students to understand the principles of bioenergetics and the dietary requirements of man and animals. It will also provide knowledge of metabolism of dietary and endogenous carbohydrate, lipid, and protein as well as the principles and major mechanisms of metabolic control and molecular signaling by hormones

**Course Learning Objectives:**

This course help students with a basic understanding of the principles of bioenergetics and enzyme catalysis, understand the chemical nature of biological macromolecules, their three- dimensional construction, and the principles of molecular recognition and demonstrates understanding of the molecular machinery of living cells in the students.

**Course Contents:**

1. Amino acids, peptides and proteins: Standard amino acids, their structure and classification; acid/base properties of amino acids and their titration curves; peptides, their ionic behavior and amino acid composition, Cytochrome C; Proteins: level of structural organization, example of structural and functional proteins.
2. Enzymes: Introduction; important characteristics of enzymes; immobilized enzymes; How enzymes work; example of enzymatic reaction; enzyme kinetics, enzyme rate of reaction and substrate concentration, how pH and temperature effect on enzyme activity.
3. Classification, types, important characteristics and structure of carbohydrates; cyclic structure of monosaccharides; cyanohydrin formation; disaccharides their types structure and function;
4. Polysaccharides, storage and structural types; structure and major functions of polysaccharides.
5. Lipids: Fatty acids, their types and major characteristics; storage lipids, acylglycerols; waxes;
6. Structural lipids in membranes; Major functions of lipids; lipoproteins, their types and major functions.
7. Vitamins and cofactors: Occurrence, structure and biochemical function of vitamins B complex group.
8. Metabolism: Detailed description of glycolysis and catabolism of other hexoses; regulation and bioenergetics of glycolysis. Anabolic role of glycolysis; fate of pyruvate under aerobic and anaerobic conditions, lactate, acetyl CoA and ethanol formation; alcoholic fermentation; gluconeogenesis, its regulation and significance in the tissues; feeder pathways in glycolysis; utilization of other carbohydrates in glycolysis phosphorolysis and starch; regulation of glycogen metabolism.
9. Citric acid (TCA) cycle: conversion of pyruvate to acetyl CoA, pyruvate dehydrogenase, a multi-enzyme complex; detailed description of citric acid cycle; bioenergetics and conservation of energy produced in the cycle. Anabolic or biosynthetic role of citric acid cycle intermediates; replenishing or anaplerotic reactions and their role; regulation of citric acid cycle; Electron transport and its components, oxidative phosphorylation, chemiosmotic theory, ATP synthesis, uncouple electron transport and heat generation.

10. Lipid metabolism: oxidation of fatty acids; digestion, mobilization and transport of fats; biosynthesis of triacylglycerol; utilization of triacylglycerol; activation of fatty acids and their transportation to mitochondria; beta-oxidation; bioenergetics of beta-oxidation; oxidation of unsaturated and odd chain fatty acids; omega oxidation pathway; biosynthesis of saturated fatty acid, supply of raw material for palmitic acid synthesis; fatty acid synthetase (FAS) multienzyme complex
  1. Ketone bodies their biosynthesis, utilization and role in the tissues;
  2. Cholesterol metabolism: steroid hormones.
  3. Nitrogen metabolism: metabolic fate of amino acids; catabolism of amino acids; deamination and transamination; nitrogen excretion and urea cycle; regulation of urea cycle.

### Practical

1. Preparation of standard curve for glucose by *ortho*-Toluidine method.
2. Tests for detection of carbohydrates in alkaline and acidic medium.
3. Tests for detection of Disaccharides.
4. Detection of Non-Reducing sugars in the presence of reducing sugars.
5. Demonstration of Acid Hydrolysis of Polysaccharide.
6. Separation and identification of various types of sugars, fatty acid and amino acid Thin Layer Chromatography (TLC).
7. Determination of pKa values of an amino acid by preparation of titration curves.
8. Biochemical tests for detection of different amino acids.
9. Separation of various protein fractions by precipitation method.
10. Demonstration of differential solubility of lipids in various solvents.
11. Quantitative analysis of phospholipids by estimation of inorganic phosphorous.
12. Quantitative analysis of Amylase activity from blood serum or liver.
13. Study on the effect of temperature on the enzymatic rate of reaction

### Recommended Texts:

1. Bhagavan N. V. (2022). *Medical Biochemistry - E-Book*. Netherlands: Elsevier Health Sciences.
2. Nelson, D., L, Cox, M. (2021). *Lehninger Principles of Biochemistry*. WH Freeman: New York.
3. McKee J. R & McKee, T (2020). *Biochemistry: The Molecular Basis of Life*. United Kingdom: Oxford University Press.

### Suggested Readings:

1. Alison, S., William, H. E & Daphne, C (2017). *Elliott Biochemistry and Molecular Biology*, (6<sup>th</sup>ed). Oxford University Press.
2. Litwack, G. (2017). *Human Biochemistry*. Netherlands: Elsevier Science.
3. Papachristodoulou, D. K. (2014). *Biochemistry and Molecular Biology* (5<sup>th</sup>ed.). Oxford University.

<b>Course Code</b>	ZOOL-5108	<b>Course Title</b>	Fisheries	<b>Credit Hours</b>	3(2-1)
--------------------	-----------	---------------------	-----------	---------------------	--------

**Course Brief:**

This course focuses on disseminating the history, needs and importance of fisheries and aquaculture. Moreover, it elaborates the basic components of pond fish culture and improves knowledge about local fish species, including culturable fishes, and their biology. It also imparts knowledge regarding fish gears and post-harvest techniques.

**Course Learning Objectives:**

Declining fish populations, marine pollution and destruction of important coastal ecosystems has introduced increasing uncertainty in important fisheries worldwide, threatening economic security and food security in many parts of the world. These challenges are further complicated by the changes in the ocean caused by climate change, which may extend the range of some fisheries while dramatically reducing the sustainability of other fisheries.

**Course Contents:**

1. Introduction to fisheries and aquaculture, national and international trends
2. Fish morphology and diversity in size and shape
3. Distribution of fishes in Pakistan, commercial fishes, marine and freshwater
4. Fish diseases: viral, bacterial, fungal and parasitic
5. Fish habitat, ecology and extant of distribution, water quality parameters (abiotic: temperature, light, salinity, pH, turbidity, etc.) and their effects on fish health and production
6. Biotic parameters (plankton, insects, aquatic vegetation etc.) of ponds, lakes, rivers and impacts on fish growth.
7. Induced breeding
8. Fish enemies and their control: insects, fishes, amphibians, reptiles, birds and mammals
9. Fishing gears, fishing techniques, fishing communities
10. Fish preservation, processing transportation and marketing

*Practical*

1. Morphological characters of a typical fish
2. Species identification, fin formula, key to identification of commercial fishes
3. Dissection of common fish to study its various systems
4. Visit to a fish hatchery
5. Introduction to artificial feed ingredient

**Recommended Texts:**

1. Sharma, O.P. (2009). *Handbook of Fisheries and Aquaculture*. Agrotech Publishing Academy, Udaipur, New Delhi, India.
2. Stickney, R.R. (2009). *Aquaculture: An Introductory Text*. CABI Publishing, London, UK.

**Suggested Readings:**

1. Pillay, T.V.R., & Kutty, M.N. (2005). *Aquaculture: Principles and Practices*. Blackwell Science Limited. New York.
2. Ali, S.S. (1999). *An Introduction to Freshwater Fishery Biology*. University Grants Commission, H-9 Islamabad

<b>Course Code</b>	BOTN-5101	<b>Course Title</b>	Diversity of Plants	<b>Credit Hours</b>	4(3-1)
--------------------	-----------	---------------------	---------------------	---------------------	--------

**Course Brief:**

This course offers an evolutionary survey of the origin and diversification of land plants through geological time. The course will start with the green algae and on how plants may have transitioned from aquatic to the land environment. Land plants that will be discussed include bryophytes, lycophytes, pteridophytes, gymnosperms and angiosperms with emphasis on representative fossil and living taxa. Lectures will emphasize on life histories, anatomical and morphological adaptations, ecology and climate change, extinction, phylogenetics, economic importance, and conservation strategies of representative taxa. Plants are one of the most successful and abundant groups of organisms on earth, comprising the majority of terrestrial biomass, being integral to ecosystem structure, and providing humans with food, shelter, and materials

**Course Learning Objectives:**

To introduce the students to the diversity of plants and their structures and significance.

**Course Contents:**

Comparative study of life form, structure, reproduction and economic significance of:

1. Viruses (RNA and DNA types) with special reference to TMV
2. Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to bio fertilizers, pathogenicity and industrial importance;
3. Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia) 4. Fungi (Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus) their implication on crop production and industrial applications.
5. Lichens (Phycia)
6. Bryophytes (Riccia, Anthoceros, Funaria)
7. Pteridophytes: Psilopsida (Psilotum) ,Pteropsida (Marsilea), Sphenopsida (Equisetum) Lycopsida (Selaginella)
8. Gymnosperms (Cycas, Pinus, Ephedra)
9. Angiosperms: Monocot (Poaceae) , Dicot (Solanaceae)

**Lab work**

1. Culturing, maintenance, preservation and staining of microorganisms.
2. Study of morphology and reproductive structures of the types mentioned in theory. 3. Identification of various types mentioned from prepared slides and fresh collections.

**Recommended Texts**

1. Bellinger, E. G., & Sigeo, D. C. (2015). Freshwater Algae. United States: Wiley Publishers.
2. Prestre, P. G. (2017). Governing Global Biodiversity: The Evolution and Implementation of the Convention on Biological Diversity. United Kingdom: Routledge Publishers.

**Suggested Readings**

1. Şen, B., & Grillo, O. (2018). Selected Studies in Biodiversity. England: Intech Open Publishers.
2. Zotz, G. (2016). Plants on Plants: The biology of vascular epiphytes. Germany: Springer-Verlag.
3. Cronk, J. K., & Fennessy, M. S. (2016). Wetland plants: biology and ecology. United States: CRC Press, 4. Pullaiah T., Bahadur, B., & Murthy, K. (2015). Plant biodiversity. Germany: SpringerVerlag